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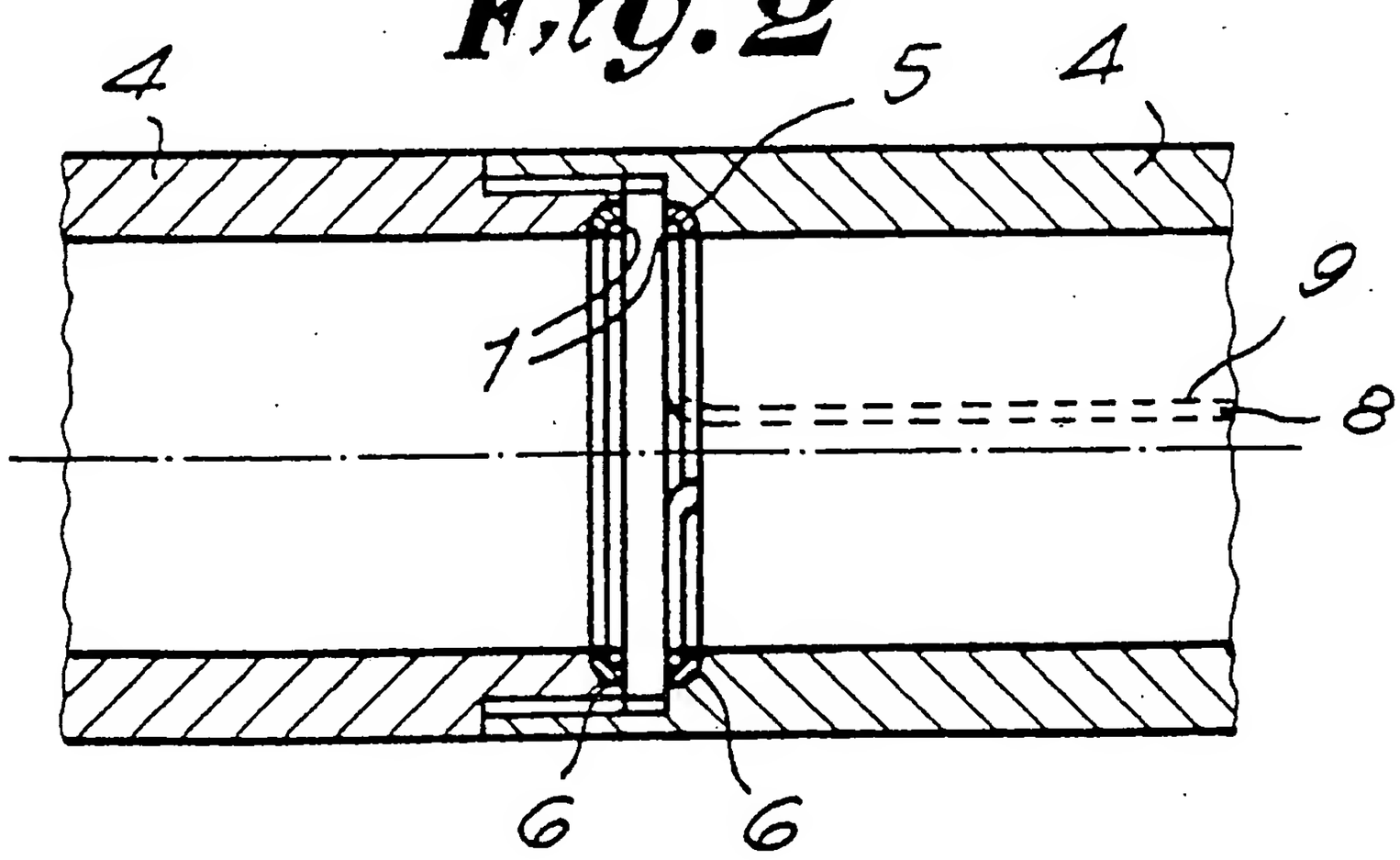
(54) Device and method for signal transmission in drill stems.

(57) Device for signal transmission in drill stems consisting of pipes (4), characterized in that the device comprises electrically interconnected induction loops (1) located in such a way that loops (1) of two pipes (4) between which the signal has to be transmitted are placed opposite each other and are coupled with a transformer coupling.

Fig. 2



EP 0 399 987 A1

The invention pertains to a device and method for signal transmission in drill stems.

In ground drillings, it is often necessary to send signals to or from the drill head, either for measuring or for controlling purposes. Currently, this is achieved by modifying the pressure of the drilling fluid, which presents the disadvantage of an extremely limited transmission speed.

The aim of the present invention is to increase said transmission speed to a considerable extent.

To achieve this goal, the pipes building the drill stem comprise electrically interconnected induction loops in such a way that loops of two pipes between which the signal has to be transmitted are placed opposite each other. Said loops are coupled by a contactless transformer coupling.

The signal is transformed and further transferred over two induction loops located opposite each other in the transmission area of two pipes. For frequencies of 1 kHz or above, the transmission can be achieved with a single winding.

Preferably the electrical connecton of the loops on a pipe is achieved over a single line or wire and over the pipe itself.

In general, as the pipes are mostly electrically conductive and form a short-circuited winding for the induction loop, losses will occur. Said losses can be limited by working with low signal voltages, for which the sender and the receiver are to be adapted by means of transformers.

The electrical resistance can be increased by providing the pipes with a suitable design in the transmission area, with the help of grooves or slots, and in such a way that the magnetic properties of the pipes are not affected. Losses can be avoided to a large extent by using a magnetic material such as ferrite, which is placed around the two opposite loops in such a way that it conducts the essential magnetic flow.

Other features and advantages of the invention will stand out from the following description of a device and method for signal transmission in drill stems according to the invention. Said description is only given by way of example and does not limit the invention; the reference numerals pertain to the accompanying drawings.

Figure 1 is a schematic representation of the electrical principle of the signal transmission according to the invention.

Figure 2 respresents schematically a longitudinal section of two pipe ends provided with a device for signal transmission according to the invention.

Figure 3 represents schematically a longitudinal section of two coaxial pipe parts provided with a device for signal transmission according to the invention.

Figure 4 represents schematically a transversal section of a pipe end provided with a device for signal transmission according the invention with respect to another form of embodiment of the invention.

Figure 5 and 6 represent sections according to lines V-V and VI-VI in figure 4.

The basic philosophy behind this discovery is the contactless transmission of signals via a transformer coupling through wires which are separated from each other and whose galvanic connection is impossible for construction reasons, as is the case e.g. in drill stems. Two conductive loops, located as close to each other as possible, are coupled inductively. At both ends of the conductive chain 2 which is coupled in this way, the adaptation to the generator or receiver circuit is achieved through transformers 3 as shown schematically in figure 1.

As shown in figure 2, the pipes 4 of the stem are screwed on each other and have adjacent ends lying in the extension of each other. On each of said ends is mounted in a groove 5 on the inside of the pipe 4, an open single-winding loop 1. The two ends lying near each other of said loop 1 at one end of a pipe 4 are electrically connected to the two ends of the loop 1 at the other end of the pipe 4 either by two wires, each of them connecting one end of one loop with one end of the other loop, or preferably, as shown in the right pipe 4 in figure 2 by means of one wire 8 connecting one end of one loop to one end of the other loop, the other ends being connected by the pipe 4 itself which pipe should then of course be electrically conductive. Said wires or wire 8 are located in longitudinal grooves 9 in the inner face of the pipe 4. If the pipe 4 is electrically conductive, the loops and the wire 8 or wires have to be insulated, e.g. by non-conductive plastic material or ferrite 6.

In principle, the transmission link which is established in this fashion is not dependent upon the direction or the frequency of the signal. However, as the material of the pipes is normally electrically conductive, the pipes themselves also constitute a conductive loop and thus become a short-circuiting winding. In order to avoid this and or to reduce the deadening caused by this phenomenon, the distance between the loop 1 and the pipe 4 must be greater than the distance between the two conductive loops 1 which are to be inductively coupled together. Embedding the conductive loops 1 in material which is magnetically active but is not electrically conductive, such as e.g. ferrite, has a positive effect.

For the inductive transmission, it is irrelevant that the coupling loops 1 are rotated symmetrically one to another, i.e. the pipes 4 can rotate independently from each other, as long as this does not modify the adjacent relative position of the loops.

In figure 2 the pipes 4 are e.g. so positioned

that the ends of open loops 1 in the pipes are not lying exactly in front of each other.

The transmission frequency is selected in such a way that the deadening is minimal. This will depend upon the actual construction and the material properties. A suitable frequency should be found above 1 kHz, e.g. within the 1 kHz - 100 MHz range.

In figure 3 a device for signal transmission is shown similar to the above described device but between two pipes 4 one of which penetrates in the other.

The pipes 4 may be mechanically connected in known ways to each other. Such connection does not affect the signal transmission. They can be telescoping pipes. Said transmission is achieved by an open loop 1 in a groove 5 in the inner face of the outmost pipe 4 and an open loop 1 in a groove 5 in the outer face of the innermost pipe 4, in front of the other loop both loops 1 being inductively coupled. Loops 1 are embedded in ferrite or non-conductive plastic material 6 holding loop 1 at a distance from the pipe material.

The signal transmission in each pipe 4 itself is achieved by an electrical connection between the loop 1 in the pipe and a next loop 1 on the same pipe.

The electrical connection comprises two wires connecting to two ends of one loop 1 to the two ends of the other loop 1, or only one wire 8 connecting one end of one loop 1 with one end of the other loop 1, and the electrically conductive pipe 4 itself connecting the other ends of both loops 1.

As far as the pipes 4 are from electrically conductive material, losses will occur as the pipes form a short circuit winding. Said losses can be limited by working with low signal voltages. The sender and receiver are therefor connected by means of suited tranformers 3 to the conductive chain 2. The losses are also avoided to a large extend by the above mentioned magnetic material 6 such as ferrite.

Losses are also decreased by increasing the electrical resistance of the pipes 4 what can be obtained by providing said pipes 4 with a suitable design in the transmission area by means of grooves 7. Said grooves 7 do not affect the magnetic properties of the pipes 4 but make the current way longer so that the court-circuit action is decreased.

It should be remarked that said magnetic properties are not essential. At high frequencies, such properties even have a deadening effect.

Claims

1.- Device for signal transmission in drill stems consisting of pipes (4), characterized in that the device comprises electrically interconnected induction loops (1) located in such a way that loops (1) of two pipes (4) between which the signal has to be transmitted are placed opposite each other and are coupled with a transformer coupling.

2.- A device according to claim 1 characterized in that the electrical connection (4, 8) of the loops (1) on the pipe (4) is achieved over a single line (8) and the pipe (4) itself.

3.- Device according to any one of claims 1 and 2, characterized in that the electrical conductivity of the pipe (1) is reduced without affecting its magnetic properties. as a result of an appropriate design, e.g. by means of slots or grooves (7).

4.- Device according to any one of claims 1 to 3, characterized in that the immediate surroundings of the induction loops (1) are lined with a magnetically active material (6) with low electrical conductivity and that the magnetic flow of two loops (1) located opposite each other is conducted through it.

5.- Device according to any one of claims 1 to 4, characterized in that it comprises transformers (3) for adapting to the signal source and to the receivers.

6.- Device according to any one of claims 1 to 5, characterized in that an induction loop (1) consists of a single winding only.

7.- Device according to any one of claims 1 to 6, characterized in that the pipes (4) are mounted end to end and each pipe (4) comprises an induction loop (1) on both ends.

8.- Device according to any one of claims 1 to 6, characterized in that one pipe (4) penetrates the other and in a transmission area, the outermost pipe (4) comprises an induction loop (1) at its inner side while the innermost pipe (4) comprises an induction loop (1) at its outer side, in front of the first mentioned loop (1).

Fig.1

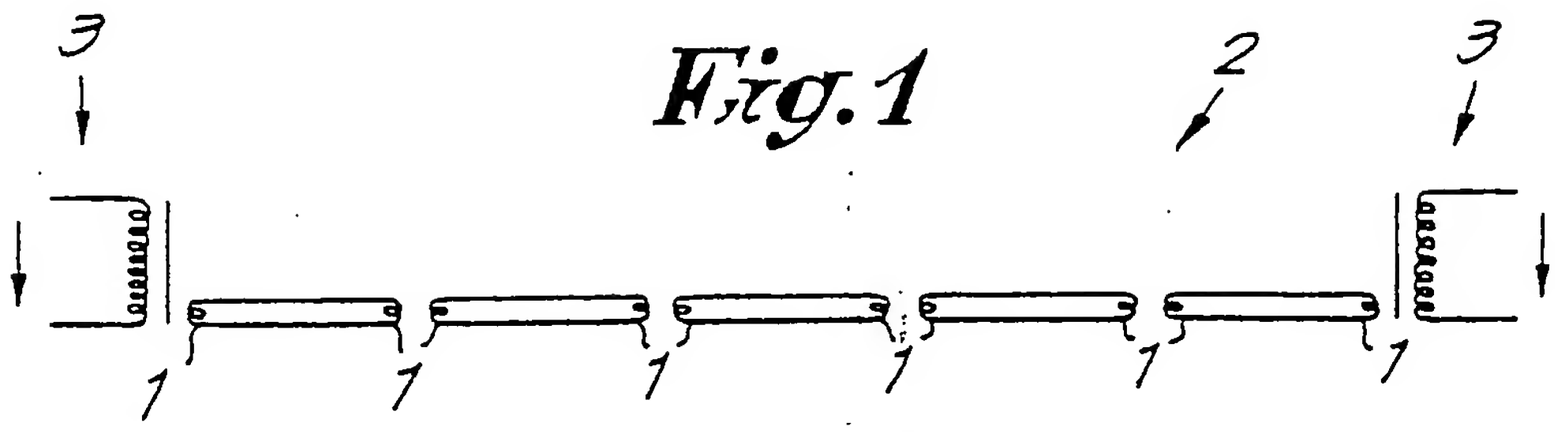


Fig.2

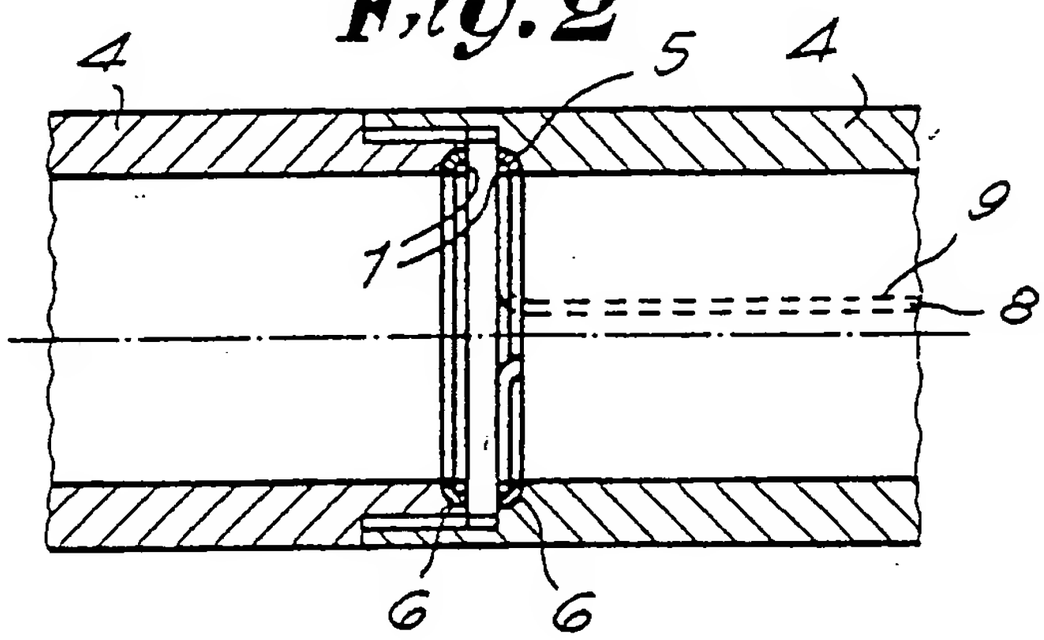


Fig.3

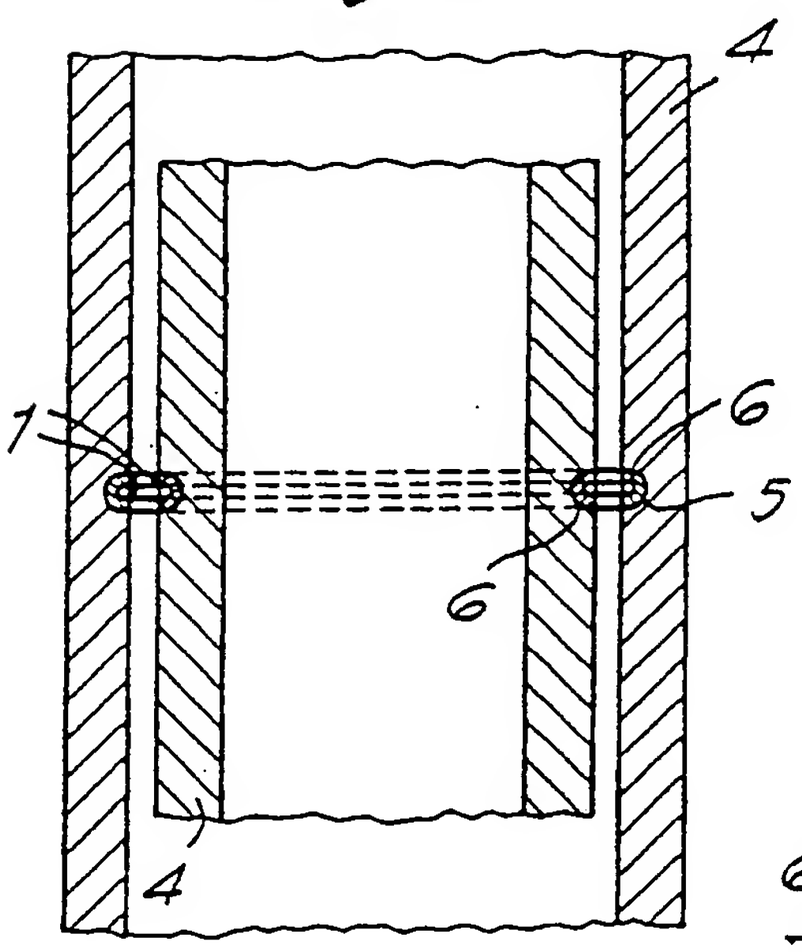


Fig.4

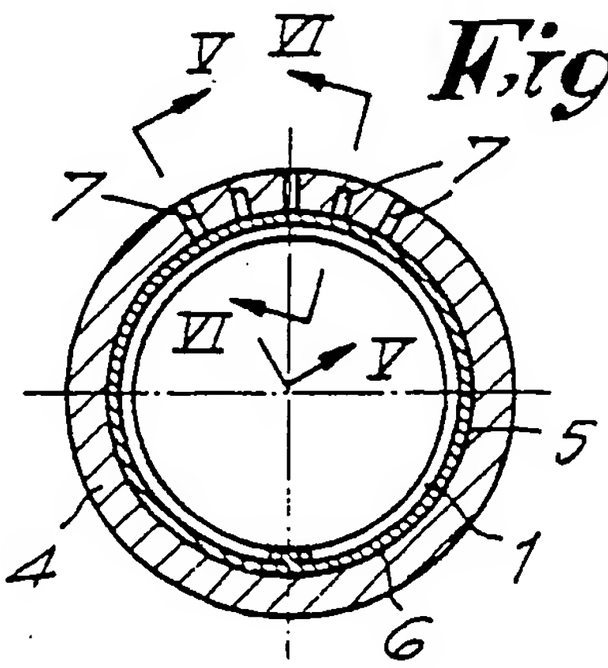


Fig.5

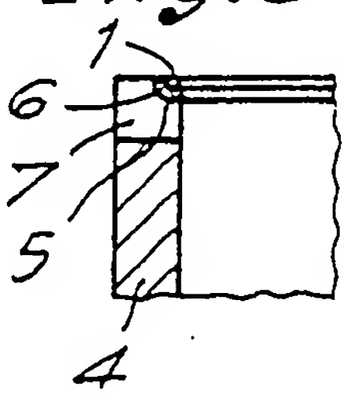
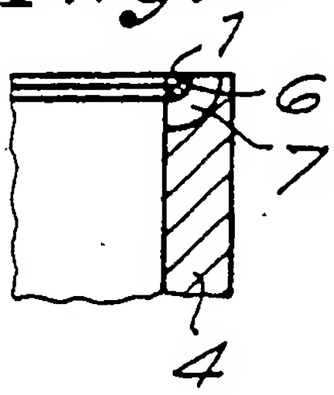


Fig.6



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EUROPEAN SEARCH REPORT

Application Number

EP 90 87 0079

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
X	US-A-2 379 800 (HARE) * Page 1, left-hand column, line 44 - page 1, right-hand column, line 16; page 2, left-hand column, lines 1-8,20-25; figures *	1,2,4,5,7	E 21 B 47/12 H 01 F 23/00 E 21 B 17/02
Y	---	8	
X	US-A-4 605 268 (MEADOR) * Abstract; column 2, lines 30-58; column 4, line 21 - column 7, line 23; figures *	1,7	
X	---	1,7	
	US-A-2 414 719 (CLOUD) * Column 4, lines 58-74; column 5, lines 30-67; column 8, lines 21-49 *		
Y	---	8	
	WO-A-8 801 096 (CONTROLOGY PROD. LTD) * Page 1, line 30 - page 2, line 11; page 2, line 30 - page 3, line 1; figure 2 *		
A	---	8	
	FR-A-2 165 074 (DROGO) * Claim 1; figure 1 *		
X,P	---	1-7	
	DE-A-3 916 704 (WELLHAUSEN) * Whole document *		

TECHNICAL FIELDS SEARCHED (Int. Cl.5)

E 21 B
H 01 F

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	31-08-1990	WEIAND T.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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